## REMARKS

Claims 1-40 remain in the application. Claims 1 and 21 are amended to emphasize distinctions over cited art.

Claims 1-2, 15, and 20 are rejected under 35 USC 102(b) as being anticipated by Gimzewski et al (U.S. Patent 6,031,756) in view of Michl et al (U.S. Patent 6,628,016 B2).

Gimzewski et al disclose a molecule layered medium and method for creating a pattern. Molecules are disclosed that can be attached to a substrate and switched between different stable and metastable conformations. At least one of these conformations is generated or stabilized by the proximity of the substrate. Further, a layered medium comprising such molecules is disclosed, and a method to switch such molecules in a controlled way is provided. The layered medium is said to be useful as resists for lithographic applications, data storage media, and a promoter of electron transfer between two media.

Michl et al disclose molecular dipole rotors, comprising a base, an axle connected to the base and oriented substantially perpendicular to the base, and a rotor portion having an electric dipole moment. The molecular dipole rotors may be attached to a surface. Arrays of molecular dipolar rotors attached to surfaces are also disclosed. The molecular dipolar rotors are purportedly useful in the preparation of small devices.

Applicants' independent Claim 1, as amended, is directed to an electric field activated molecular switch comprising a molecular system that has an electric field induced band gap change resulting from a change in conjugation as p,$\pi$-electrons of the molecular system, through its highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO), are alternately localized and delocalized over the entire molecular system by an applied electric field.

Dependent Claims 2, 15, and 20 depend from Claim 1.

The Examiner argues that Gimzewski et al disclose a molecular switch that switches conformation and has electronic states that can differ in their potential energy, wherein the potential energy diagram is characterized by potential minima. The Examiner also argues that the molecule has extended conjugation and that there are

bonds around which the molecular groups can rotate, referring to Figure 3. The Examiner states that the application of an electric field brings about the switching and the application of a voltage brings about the switching. The Examiner states that the substrate shown in Figure 5b can have electrodes between which are attached the molecules. The Examiner states that in Figure 5c the molecular switch is shown between two surfaces, the substrate and the actuators. The molecular switches are said to have groups that can rotate around bonds. The Examiner points to Figures 1b and 1c as indicating that there can be stretching of bonds as one of the changes. The Examiner notes that Figure 5c shows the molecular switches sandwiched between electrodes 4 and 31 through which a voltage is applied to the molecular switch layer and that among the uses of the molecular switches are in data storage, "which would indicate memories".

The Examiner admits that Gimzewski et al are silent with respect to the change of energy gap which comes about by the change in extended conjugation, but argues that Michl et al disclose a molecular switch (in col. 9, lines 15-20 and col. 17, lines 64-67) in which the rotor of the molecular switches can have extended conjugation (col. 7, structures 11-14) and that the substituents of the aromatic groups of the rotor can have charges as in structure 14. The Examiner further argues that the application of an electric field would result in changes in the conjugation which would depend upon the polar groups which are attached to the polar groups.

Applicants have previously presented arguments as to why Gimzewski et al do not even remotely disclose Applicants' claimed invention, without response from the Examiner as to the points Applicants have raised. Those arguments obtain here as well.

The present invention is directed to an electric field molecular switch comprising a molecular system (typically, the molecular system is maintained between two electrodes). The molecular system has an electric field (E-field) induced band gap change; that is to say, when the molecular system experiences a change in conjugation from more fully conjugated to less fully conjugated (and *vice versa*) as a result of an applied E-field, a change in the band gap is induced. This comes about as p,$\pi$-electrons of the molecular system, through its highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO), are alternately localized

and delocalized over the entire molecular system by the electric field. There are a variety of ways to accomplish this localization/delocalization of p,$\pi$-electrons:

(1) molecular conformation change or an isomerization;

(2) change of extended conjugation via chemical bonding change to change the band gap; or

(3) molecular folding or stretching.

It is important to note that the band gap change results from a change in conjugation. Specifically, it is insufficient for a mere change in conformation (say, from a cis to a trans configuration) to cause the band gap to change. Rather, it is the change from a more fully conjugated state (e.g., electrons delocalized over the entire molecule) to a less fully conjugated state (e.g., electrons localized). Claim 1 has been amended to reflect the change in conjugation. The former state results in a relatively smaller band gap, while the latter state results in a relatively larger band gap. Claim 1 is further amended to delete the three mechanisms (these are covered in various dependent claims) and instead recite the localization/delocalization of p,$\pi$-electrons through the HOMO/LUMO of the molecular system. The HOMO-LUMO band gap is discussed throughout the specification; see, e.g., paragraphs 0081, 0086, 0090, 0097, 0105, 0111, 0120, 0121, 0123, 0126, 0130, and 0131. The language of amended Claim 1 is largely taken from paragraph 0121.

All claims are based on the change in the HOMO-LUMO band gap as a result of an applied electric field. Neither Gimzewski et al nor Michl et al disclose such a change in the HOMO-LUMO band gap as a result of an applied electric field.

Conformational changes of a molecule can change the molecular band gap only if the changeable portion(s) of the molecule belong to part(s) of a large conjugation system in one of its stable conformational states. In such a state, all portions of the large conjugation system of the molecule have to be in the same plane conformation. Otherwise, no HOMO-LUMO band gap can be changed no matter how the molecular conformational changes. Both Gimzewski et al and Michl et al lack such a large conjugation system, contrary to the Examiner's assertion. Further, neither reference discloses a mechanism for interrupting that conjugation to change the molecule to a less conjugated state.

There simply is not the slightest disclosure or suggestion by Gimzewski et al that there is a change in the conjugation of the molecule between conformations **18** and **19**. Gimzewski et al state "The electron transfer (ET) capability is determined by the properties of the electronic states of the molecules. The latter are different in the different conformations 18, 19 of the molecules." Thus, the so called "electronic states" of the molecules of Gimzewski et al due to various conformational states are strictly related to the ease for charge injection from electrode to center unit (the porphyrin ring). The efficiency of charge injection is related closely to the distance between the injecting electrode and the charge accepting center unit (the porphyrin ring). The molecular conformational change of this reference will only change the change in injection gap of injecting electrode and charge accepting center unit (the porphyrin ring). There is nothing in this disclosure that is related to a molecular band gap change in Applicants' invention.

For example, the molecule in Fig. 3 of Gimzewski et al does not have extended conjugation in one rotational state and broken or reduced conjugation in another rotational state. A condition of conjugation between two rings is that the rings must be planar with respect to each other. Without planar conformation, the pi electrons between the rings cannot overlap. Applicants' aspect of their rotor-stator embodiment, for example, is the rotation of adjacent rings out of planarity to break conjugation between the rotor and stators.

Not only does Gimzewski et al fail to teach a change in conjugation, their molecules are designed ***away*** from conjugation. Their Fig. 3 is essentially a 2-dimensional projection, to show the details of the molecule, but there should not be any inference that the molecule is coplanar throughout; see, their Fig. 1a. Indeed, even in the second "state" of Gimzewski et al, co-planarity is not achieved, as argued above, and as shown in their Fig. 1b.

The Examiner cites structures 11-14 (Col. 7) of Michl et al as showing rotors of molecular switches that can have extended conjugation. However, it would be apparent to one skilled in this art that whatever the moiety is that is doing the rotating on these structures in no way affects the conjugation (and hence the band gap) of the structure. These rotors are designed to oscillate (Col. 8, lines 17-26). But nowhere do Michl et al disclose or suggest a change in conjugation or a change in the HOMO-

LUMO band gap resulting therefrom. Indeed, the rotating part of the structure is connected to the main part of the structure by way of a sigma bond or a coordination bond. Thus, the pi-system, if present, is isolated from the rotor. As a consequence, no extended pi-conjugation is altered by rotation of the rotor, and no change in the HOMO-LUMO band gap takes place.

In the instant application, because of the relative conformation changes between one state and the other, the highest occupied molecular orbital (HOMO) and/or the lowest unoccupied molecular orbital (LUMO) can be delocalized over the entire molecule (the molecule is an electrical conductor), or they can become localized on one portion or different parts of the molecule (the molecule is an electrical resistor). As a result, the electron energy band-gap of the molecular system will change accordingly (e.g., small for the conductor state, and large for the resistor state). Neither cited reference discloses or even remotely suggests such a change.

Consequently, even if the teachings of Gimzewski et al were combined with those of Michl et al, the combination would not suggest to one of skill in the art that an electric field activated molecular switch may comprise a molecular system that has an electric field induced band gap change resulting from a change in conjugation as p,$\pi$-electrons of the molecular system, through its highest occupied molecular orbital (HOMO) and lowest unoccupied molecular orbital (LUMO), are alternately localized and delocalized over the entire molecular system by an applied electric field, as recited in amended Claim 1. "To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974)". M.P.E.P. § 2143.03. Accord, M.P.E.P. § 706.02(j). Consequently, for at least these reasons, the rejection based on the combination of Gimzewski et al and Michl et al should be reconsidered and withdrawn.

Reconsideration of the rejection of Claims 1-2, 15, and 20, as amended, under 35 USC 103(b) as being unpatentable over Gimzewski et al in view of Michl et al is respectfully requested.

Claims 3, 6-8, 11, 12, 16, 18, 19, 21-23, 26-28, 31-32, 35, 36, and 38-40 are rejected under 35 USC 103(a) as being unpatentable over Gimzewski et al in view of Michl et al and further in view of Heath et al (U.S. Patent 6,198,655).

The Gimzewski et al and Michl et al references are discussed above. Heath et al disclose electrically addressable volatile and non-volatile molecular-based switching devices. The molecular devices include certain [2] catenanes as bistable molecules which are sandwiched between two switch terminals. The switches are said to be extremely small and have dimensions which range from several microns down to a few nanometers. This reference is quite similar to U.S. Patent 6,459,095, cited in paragraph 0002 of the present specification in its disclosure of catenanes.

The Examiner admits that Gimzewski et al and Michl et al are silent with respect to the recited limitations of the claims with respect to the first and second states and the relationship to the rotor portion and with respect to the junction as recited in the claims. However, the Examiner argues that

> "... it would have been obvious to one of ordinary skill in the art at the time of the invention from Fig. 3 and relating Fig. 3 to Fig. 4a and Fig. 4b that there are rotor portions of the molecule as shown in Fig. 3 and labeled 3 in the figure and that Fig. 4a and 4b show the minima and the maxima in the energy of the molecule with the conformation changes. In addition, the molecule has extended conjugation as shown in Fig. 3, and that this can also be a mechanism of raising the molecule to an excited state (col. 3, lines 25-28), as is well known in the art that there can be pi-bond breaking and forming as part of the conformation changes."

Applicants have discussed Heath et al extensively in their previous Amendment. Essentially, Applicants showed that Heath et al disclose and claim reduction-oxidation (redox) reactions to effect switching, whereas Applicants' invention is directed to an E-field induced molecular conformation change via a ***non***-redox process (see paragraph 0071 of the present specification). If the Examiner is arguing that it is reasonable to combine Gimzewski et al and Heath et al, then this implies that Gimzewski et al must also be directed to a redox process. Otherwise, the combination of a non-redox process and a redox process would be untenable. In this case, two redox references combined would still not disclose or suggest Applicants' non-redox process, and the rejection falls.

If, on the other hand, Gimzewski et al are directed to a non-redox process, as implied from the Examiner's comments regarding the 102 rejection, then the combina-

tion is clearly untenable, for how would one combine two references disclosing entirely different mechanisms.

Either Applicants' claims are unpatentable over Gimzewski et al or over Heath et al, but not over a combination of both. As shown in Applicants' previous Amendment, Heath et al cannot render Applicants' claims unpatentable, due to the entirely different switching mechanism. Applicants have raised this point before, but the Examiner has not responded thereto, merely reiterating his previous arguments.

The arguments made above with regard to the combination of Gimzewski et al and Michl et al obtain here as well. Adding Heath et al fails to overcome the lack of disclosure or suggestion of the other two references, as argued above.

Consequently, even if the teachings of Gimzewski et al were combined with those of Michl et al and Heath et al, the combination would not suggest to one of skill in the art the aspects recited in the various rejected claims. "To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974)". M.P.E.P. § 2143.03. Accord, M.P.E.P. § 706.02(j). Consequently, for at least these reasons, the rejection based on the combination of Gimzewski et al, Michl et al, and Heath et al should be reconsidered and withdrawn.

Reconsideration of the rejection of Claims 3, 6-8, 11, 12, 16, 18, 19, 21-23, 26-28, 31-32, 35, 36, and 38-40, as amended, under 35 USC 103(a) as being unpatentable over Gimzewski et al in view of Michl et al and further in view of Heath et al is respectfully requested.

Applicants appreciate that Claims 4, 5, 9, 10, 13, 14, 17, 24, 25, 29, 30, 33, 34, and 37 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. However, based on the foregoing arguments, Applicants assert that the remaining claims are also allowable.

The foregoing amendments and arguments are submitted to place the application in condition for allowance. The Examiner is respectfully requested to take such action. If the Examiner has any questions, the Examiner is invited to contact the undersigned at the below-listed telephone number. HOWEVER, ALL WRITTEN COMMUNICATIONS SHOULD CONTINUE TO BE DIRECTED TO: IP ADMINISTRATION,

LEGAL DEPARTMENT, M/S 35, HEWLETT-PACKARD COMPANY, P.O. BOX 272400, FORT COLLINS, CO 80527-2400.

Respectfully submitted,

January 19, 2006

David W. Collins

David W. Collins
Reg. No. 26,857
Attorney for Applicants

512 E. Whitehouse Canyon Rd.
Suite 100
Green Valley, AZ 85614

Telephone calls may be made to:
(520) 399-3203